day 83

2] particle moves along x-axis

$v(t) = -(t+1)\sin\left(\frac{t^2}{2}\right)$

initial value problem

At $t=1$, $x=1$ [meaning $x(0)=1$]

a) find $a(2)$

$a(t) = \frac{d}{dt}(v(t)) =$

$\frac{d}{dt}\left(-(t+1)\sin\left(\frac{t^2}{2}\right)\right)$

position
anti-derivative
deriv
velocity
anti-derivative
derivative
acceleration

$a(2) = v'(2) =$

nDeriv(v(x),x,2) = 1.5875866

[[nDeriv(-(x+1)sin(x²/2),x,2)]]

a part 2) to evaluate speed,

COMPARE velocity AND acceleration!

$a(2) = 1.5875$

$v(2) = -2.72789\ldots$

SLOWING DOWN

(because signs of v(t) and a(t) are opposite)

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2b) where does particle change direction?

⇒ when $v(t)$ is undefined or 0

$v(t)=0 \Rightarrow t+1=0 \Rightarrow t=-1$ out of domain

OR

$\sin\left(\frac{t^2}{2}\right)=0$

$\frac{t^2}{2}=0 \Rightarrow t=0$

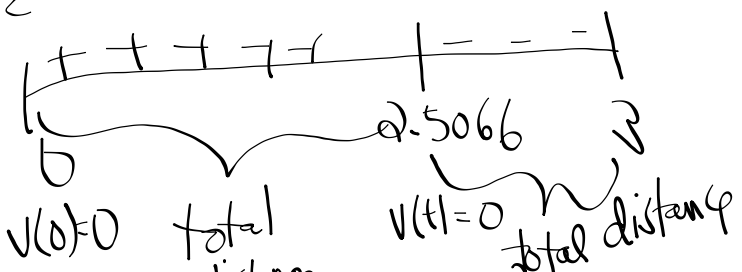
$\sin\left(\frac{t^2}{2}\right)=0, \pi, 2\pi, 3\pi, 4\pi, \ldots$

$-\pi, -2\pi, \ldots$

$\frac{t^2}{2}=\pi \Rightarrow t^2=2\pi \Rightarrow t=\sqrt{2\pi}\approx 2.5066$

$\frac{t^2}{2}=2\pi \Rightarrow t^2=4\pi \Rightarrow t=2\sqrt{\pi}$ out of domain

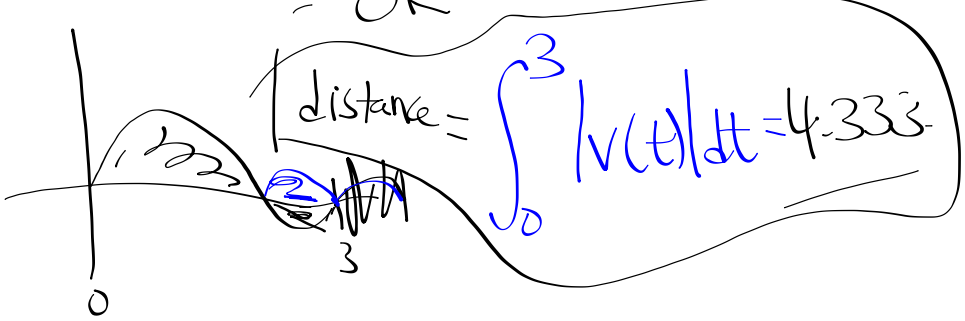
c)



$$\text{distance} = \left|\int_0^{2.5066} v(t)\,dt\right| + \left|\int_{2.5066}^{3} v(t)\,dt\right|$$

total displacement is the ACCUMULATION of all the minuscule changes of displacement.

- OR -



$$\text{distance} = \int_0^3 |v(t)|\,dt = 4.333$$

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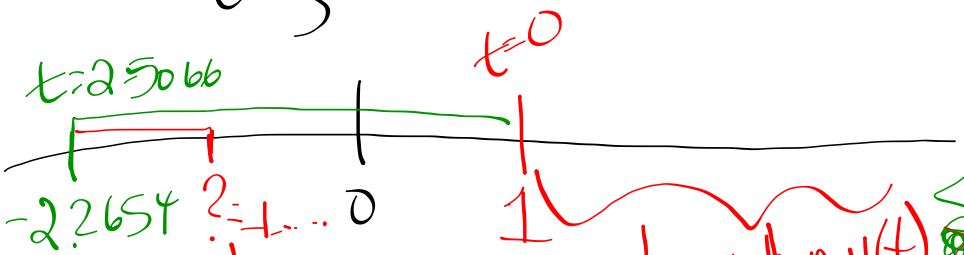
d) - the toughie . . .

greatest distance between particle and Origin



dg when $v(t) \leq 0$

farthest right = start + change

$= 1 + \int_0^{2.5066} v(t)\,dt$

$= 1 + -3.2654$

$= -2.2654$

$?= -2.2654 + \int_{2.5066}^{3} v(t)\,dt$

$= -2.2654 + 1.0683339$

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$$\int_{a-2}^{a+2} f(x)\,dx = \int_{a-2}^{a} f(x)\,dx + \int_{a}^{a+2} f(x)\,dx$$

$$\int_0^2 f(a+u)\,du$$

?

Let $x = a-u$

$u = a-x$ $\quad du = -dx$

$x = a \Rightarrow u = 0$

$x = a-2 \Rightarrow u = a-(a-2) = 2$

$$-\int_2^0 f(a-u)\,du$$

$$= \int_2^0 -f(a-u)\,du$$

$$= \int_2^0 f(a+u)\,du$$

$$= -\int_0^2 f(a+u)\,du$$